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School life.
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SCHOOL LIFE,

AND ITS

INFLUENCE ON SIGHT,

BY

GEORGE REULING, M. D.,

Surgeon to the Maryland Eye and Ear Institute, Baltimore.

Read before the Teachers' Association of Baltimore, December 2d.

BALTIMORE:
JOHN H. FOSTER'S STEAM PRINTING AND PUBLISHING HOUSE,
No. 9 South Charles Street,
—1877.—

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BY GEORGE REULING, M. D.,

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The subject concerning which I have been requested to make a few remarks, ladies and gentlemen, is one which is of very great importance, as it treats of the influence school-life exerts upon the sight of children.

If we could be taken back to the walks of the Academy, to the age of Socrates and Plato, when instruction was restricted to oral communication, we would find almost all learners to have clear vision. The same immunity from painful and weak sight is discoverable in our days among all people who do not use their eyes to any extent for near work, as among the aborigines of this country, the Indians.

Modern usage, however, has changed all this. The vast amount of learning which the progress of industry has called forth, the many fields of science which it has unclosed and rendered fruitful, are too numerous to impress themselves on the mind simply through the channel of verbal instruction. Close application is absolutely necessary now-a-days in order to keep pace with the requirements of our civilization. This being the case, it is of the first importance to make this necessity as little baneful in its effects as possible.

The human eye is very delicate in its construction, and a continuous strain upon its muscular apparatus is painful, the more so if light is not adequately and well provided, and if the posi-

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tion occupied while studying is improper. But these conditions give rise not only to painful vision, but to permanent injury as well.

It is not my intention to enter into a scientific exposition of the eye and its structure; in order to understand how vision may become impaired by improper surroundings, it is necessary, however, to give you a general idea of the three most frequent formations of the human eye;—the normal or emmetropic eye, in which the image is focused upon the retina; the myopic or short-sighted eye, in which it is focused in front of it; and the hypermetropic or over-sighted eye, in which it is focused behind it.

The normal eye is spheroidal in shape, and is so constructed that rays of light coming from a distance, that is, parallel rays of light, come to a focus upon the retina, which is the nervous internal lining membrane of our eyes. This takes place without effort or fatigue. When, however, the shape of the eye is not that of a sphere, but when it is too flat in the direction from before backwards, then rays of light cannot be brought to a focus *upon* the retina; on account of the shortening of the axis of the eye, this takes place *behind* it. Convex glasses increase the convergence of the rays of light, and should, therefore, be worn, in order to unite them upon the retina. Such an eye is not normal, but hypermetropic or *over-sighted.*

Again, if instead of being spheroidal, the eyeball is too long, or egg-shaped, then the axis is lengthened and rays of light which are parallel, that is, come from a distance, are brought to a focus in front of the retina. Such an eye is *myopic* or short-sighted. In neither case, however, can a correct image be formed upon the retina; neither when the eyeball is too flat nor when it is egg-shaped, and difficulty in seeing, accompanied by pain, is the result in each condition.

I have said that improper illumination and an incorrect posture are productive of bad results; the worst of these is the state of the eye of which I have just spoken; I refer to short sight. It is a fact that this affection is first noticed when children go to school, and people often wonder that this should be so; it can, however, be readily explained. You all know, at least all of you

who have good eyes, that a piece of written or printed matter which you can discern with ease at the distance of three feet can be distinguished by you, although you approaeh it very closely to your eyes. At three inches, however, you will find great difficulty in making it out, and at the distance of two inches this will scarcely be possible. How is this to be accounted for?

When we look at near objects a change takes place in the interior of the eye, which change is associated with a certain exertion. The eye being an optical instrument is supplied with a lens, which grows more convex in order to produce images of very close objects upon the retina. This increased curvature is brought about in the following manner: The anterior surface of the lens gets to be more convex and moves forwards, whilst the posterior surface, although it also becomes more convex, does not change its position. The ciliary muscle produces this change in the curvature of the lens; according to late experiments the rationale of this action is to be explained in the following way: The ciliary muscle, or the muscle of the accommodation, contracts and pulls the second lining membrane of the internal eye, the choroid, forwards, the anterior and internal margin of the ciliary body inwards, and lengthens the fibres of the ligament which subtends the lens; by this means the space around the iris is widened and the interval between the anterior surface of the lens and the cornea is narrowed in consequence, because of the pressure exerted upon the capsule of surrounding envelop of the lens, whereby its curvature is increased as above explained.

When we look in the distance the ciliary muscle is inactive, since, in the observation of far objects, the lens requires only its ordinary curvature; to look in the distance, therefore, is not painful under normal circumstances. Whenever we observe close objects, *i. e.*, whenever the ciliary muscle is called into action, the fluid within the back part of the eye is under a higher pressure, owing to the increased muscular action.

But the membranes of the eye—of which there are three—are very fragile and easily impressible; on dissection the two inner ones are found to be extremely thin. This is even more so in the case of children. When the child goes to school and first

makes use of its eyes for near work, therefore, the following is found to result: The muscle of the accommodation is frequently employed, the hydrostatic pressure within the eye is increased, and consequently the most yielding portions of the impressible membranes of the back part of the eye are expanded or bulged out, and the axis of the eye is lengthened. The *axes of the eye* is a a name given to an imaginary straight line drawn from the centre of the cornea, which is the glistening portion covering what is popularly called the "sight" of the eye, to the centre of the retina, the internal lining membrane of the eyeball. When this is too long, rays of light which come from a distance, and therefore are parallel, cannot be united upon the retina as they ought to be, but come together *in front* of it, and the eye becomes near-sighted.

But not only when the accommodation of the eye—this means that the eye after looking in the distance and being in a state of rest *accommodates* itself for near objects—is employed for too long a time or under unfavorable circumstances is the pressure increased; when the eyeball is overfilled with blood the same effect is produced. This surcharge of blood always ensues when the head is bent forwards for any length of time; this position therefore is also able to produce short sight.

When, however, the eye expands in this manner from before backward—the case, as I have said, with every short-sighted eye—the yielding posterior portions may be further pressed upon and a creeping inflammation of the second lining membrane of the internal eye near where the optic nerve enters may be produced, which causes the gradual disappearance of this membrane, the choroid, at this place. This disappearance of the choroid is called *posterior staphyloma*, and takes place in about 31 per cent. of all short-sighted cases.

Since it is an established fact that continued observation of near objects and a position which causes the body to lean forward are able to render a healthy eye near-sighted and a naturally near-sighted one yet more so, it is very important to pay attention to the school accommodations of children, more especially to the structure of the desks and seats which they are obliged to occupy.

But it is not alone the desks and the seats which are of importance to us; the means and manner of lighting the apartment in which the children are congregated ought to be considered as well. We all know that we are obliged to approach our eyes so much more closely to an object as the light in the room loses in intensity. If, as is frequently the case, the manner of lighting the school room is not proper, the eyes of the children must be brought very near to the reading or writing matter, that is, the head must be inclined forwards while reading or writing. But this position increases the supply of blood within the eye and thus materially adds to already existing short sight and not unfrequently calls it forth.

It may be said in this place that highly short-sighted parents *may* have perfectly normal-sighted children; in the great majority of cases, however, these are born with oblong eyes, that is, with eyes having too long an axis.

The predisposition to short sight is present in such children, and is developed during school life in proportion to the adversity of the external conditions already mentioned, and they will of course be more easily impressed than others in whom no hereditary predisposition is present.

But it may be asked is short sight a disease? Are its effects so pernicious as to necessitate prevention by the employment of all possible means at our command?

The answer to this is decidedly in the affirmative. The tendency of short sight, if not arrested in its progress, is to destroy the eye. But you may say it is generally supposed that near-sighted eyes are the most durable. This is one of those popular fallacies which are so hurtful in their effects upon the community. The reason why this belief prevails is because short-sighted eyes can see near objects at a time of life when normally constructed eyes must use convex glasses. This necessity, however, is the result simply of natural changes in the ciliary muscle as well as in the firmness of the lens, which is situated within the eye. I have said that when we look at near objects, the muscle of the accommodation presses upon the lens and increases its curvature; as age advances, from the forty-fifth year upwards, the lens gets

harder, and consequently it will not quickly respond to the pressure exerted upon it by the little muscle, but since in order to see near objects distinctly a greater convexity is required, and as the lens will no longer respond without effort to the action of the accommodative muscle, artificial means are called for to remedy this condition; in other words, we add to the convexity of the lens, which can no longer be brought about by the pressure of the muscle within the eye, by placing a proper convex glass in front of the eye, which answer a similar purpose. It will be seen that this is but the result of advancing years, merely a physiological condition.

Short sight on the other hand is virtually a disease. I have explained how pressure exerted upon the soft, yielding membranes may produce this condition, and also eventually call forth an atrophy, a degeneration, a thinness and gradual disappearance of a portion of the choroid membrane situated in the vicinity of where the nerve of sight enters the eye. But not only may this result. After the eyeball has expanded to a certain extent the membranes become so thinned, and their power of resistance is so much lessened, that the greatest dangers are to be apprehended. For if the short sight goes on increasing in intensity, sight may be completely lost, usually about the fiftieth or sixtieth year, and sometimes at an earlier age, inasmuch as a fluid may collect between the retina and the choroid, the two internal lining membranes, and consequently detach them the one from the other; the result is incurable blindness.

On account of these considerations it is necessary carefully to watch each case, and to pay stringent attention to all those surroundings which are calculated to produce or to develop this desease.

My friend, Dr. Cohn, a physician in Breslau, the chief city in Silesia, having 33 schools, in which, on an average, 10,060 children are instructed, found upon careful examination of *all* the pupils, that of this number one thousand and four, or *ten per cent. of all the children*, were near-sighted; a fearfully large percentage.

He further found that *no school* was free of short-sighted pupils, and that the number increased, and the degree of the dis-

ease grew more intense from the lowest to the highest class in each school.

Dr. Cohn showed moreover that out of the entire number only 28 had inherited their short sight, that is, the father or the mother of only 28 out of 1,004 children were near-sighted. This small number proves that hereditary causes must be left out of all consideration, and that the increase of short sight, and in the great majority of cases its origin, are entirely due to the influence of school-life.

How, therefore, ought the seats and the desks to be constructed, and in what manner should the school-room be lighted in order to prevent the spread of this evil?

I have not as yet been able to make personal examination of the arrangements in the various schools in this city; although it is my intention to ask your permission to do so as soon as my time will permit.

I can therefore not speak from my own observation of the appliances and the external conditions which obtain in the public schools of Baltimore; I shall nevertheless give you an idea how the light and in what manner the desks and seats should be arranged in, for instance, a model school.

In the first place, then, the size of the pupils must be taken into consideration, and, as a general rule, the seat should never be higher than the length of the child's leg, from the knee downward. According to measurement this is two sevenths of the height of the entire body.

In the second place, the difference in height between the desk and the seat must always be equal to the distance of the elbow from the latter, the arm hanging loosely down. This distance amounts to one-eighth of their size in the case of boys plus one inch; it amounts to one-seventh of their size in girls.

In the third place, the *horizontal* distance between seat and deskboard ought either to be equal to zero, or, which is preferable, the inner margin of the desk ought to extend about one inch beyond the external margin of the seat. By this means the pupil is enabled to take hold of the book without bending his body forwards and approaching his eyes too closely to the letters.

The deskboard should have a breadth of 18 to 19 inches, three of which occupy a horizontal, and 15 to 16 an inclined position; the inclination should be equal to about 2 inches.

The proper distance at which the writing or reading matter is to be from the eyes of children is from one and one quarter to one and one-half feet.

The seat ought to have a width of ten inches at least, and should be supplied with a back, high enough to act as a support to the lumbar vertebræ, that is to say, to the loins, but not higher.

How important it is that this back be employed, and no other, can be best discovered by the following which is extracted from a lecture delivered by Prof. Liebreich, of London, on school-hygiene.

He says: "If the back is wanting or unsuitable, the strength of the muscles which keep the spine straight is not sufficient to maintain it long in an upright position; the body stoops and the lower part of the spine becomes bent forwards, presses on the viscera and lungs and prevents the free action of these organs. If the child has to read a book placed on a table at too great a distance, it sits on the edge of the seat, a very unhealthy and fatiguing position. It rests the body on its arms, and, if the difference between the desk and seat is too great, the chest is supported by the projecting shoulders, instead of the shoulders resting on the chest. Soon this position becomes too fatiguing; the head bent forward becomes too heavy, and must be supported by one or both hands at the temples, or by the chin resting on both arms. Thus every possible modification of the two positions immortalized by Raphael in the two angels at the feet of the Sixtine Madonna is adopted by the children; but while the angels look into the far ether, our children stare into a book, which, in one of these positions is only two or three inches from the eye, and in the other sideways from the head, and therefore at an unequal distance from the two eyes.

It is still worse when writing. With desks and seats of the ordinary forms, only one arm rests on the table—this is generally the right, while the left hangs so that the elbow approaches the

left knee, and only the tips of the fingers hold the book on the table. The edge of the book is no longer parallel with the rim of the table, but slanting or even perpendicular to it. * * * The consequence is, that 20 per cent. of all school-boys, and 40 per cent. of girls have one shoulder higher than the other. The well-known orthopedic surgeon, Eulenburg, states, moreover, that 90 per cent. of curvatures of the spine, which do not arise fom a special disease, are developed during school life. These statements have particularly struck me as coinciding exactly with the period of the development of short-sight, and I have paid the more attention to this relation between spinal curvature and short-sightedness, as they seem to form a *circulus vitiosus*, in so far as short-sightedness produces curvature and curvature favors short-sightedness, whilst evidently the same bad arrangements are at the foundation of both these anomalies."

These remarks will show how necessary it is to attend to the correct and scientific construction of both desk and seat.

It is important that the feet of the children touch the floor; for no child, especially when writing, can let its legs dangle in the air for an hour or more. In order to secure a firm foot-hold it will instinctively bend its legs backward, and will, consequently, bring its body just as far forwards as it endeavors to place its feet backwards in order to reach the floor with its toes; consequently, a position is assumed which, as I have before told you, is productive of short sight.

All seats which are too high should, therefore, be supplied with foot-boards, the width of which need not be above 6, although 9 inches are preferable, and should be placed below the front rim of the seat in such a manner that even children of the lowest classes can conveniently place their entire feet upon them. The back margin of the foot-board must be placed so as to be below, and one inch behind, the front margin of the seat; by this arrangement the children can more easily get to their seats or leave them whenever called upon to do so.

In order that children can stand up while reciting and so forth, a contrivance ought to be made by which the deskboard can either be pushed back or turned over.

In concluding the consideration of the desk, I will draw your attention to the fact that it must be so arranged that it is just so high as to let the elbow rest upon it without displacing the shoulder.

Having treated of the desk and the seat, I will now turn my attention to the manner in which the school room ought to be lighted.

I have said that insufficient or bad illumination is in itself the not uncommon cause of short-sight.

The windows should always be arranged in such a manner that sunlight enters from that side which is not hurtful to the eyes of pupils, while at the same time it illuminates their work sufficiently. Skylights are admirable in this respect, and, in addition, windows situated to the left of the pupils are advisable. The worst arrangement is that where the light enters from the right side; in that case the hand casts a shadow on the portion of paper which is to be written upon, and consequently necessitates a too close approach of the eye, which position of the head, as you know, is favorable to the production of short-sight. The amount of sunlight which is able to enter the school room will, of course, be regulated by the height and breadth of the windows. A room in which 60 to 80 children are to be placed must be, *at the least*, 14 to 15 feet high; it is no misfortune if it is higher. The windows of such a room should have a height of 9 feet, and a width of 6 or 7 feet. Windows constructed in this manner will give each pupil his percentage of light.

It is, moreover, a matter of great importance to take into consideration the width of the street in which a school house is to be erected, and the altitude of the buildings opposite to it; for the narrower the street in which it is built, and the higher the opposite houses, and the lower the story in which the class is situated, the greater the percentage, the larger the number of short-sighted children.

But it is not alone the windows and the side from which the light must come which must be considered, the color of the walls or wall-papers must be looked to as well. Neither white, nor

blue, nor green, nor dark grey is to be selected. The best color is *light grey*, and the walls should thus be coated afresh as soon as they become dirty.

Respecting artificial illumination, some little may be said.

It is necessary that all gas jets be supplied with a cylinder or chimney, in order to keep the flame from flickering, which alternate changes between light and dark may be a not unimportant factor in the production of short sight. Besides chimneys, lampshades are required in order to diffuse the light equally, and to produce a proper illumination.

Having now spoken in brief of the manner in which a school ought to be constructed in order to prevent the rise and spread of short sight, I will conclude my remarks by saying a few words concerning the kind of glasses which should be worn by short-sighted children, and the dangers arising from a careless selection.

Suppose a person has a degree of short sight amounting to 30—that is, suppose he can see objects well at the distance of 30 inches, but no further, then a glass which neutralizes his short sight, or a concave glass No. 30, will enable him to discern objects situated farther off than thirty inches, objects, in fact, as far off as a normal eye can see them. How is this, to be explained? In this manner: The far point of clear vision depends upon the length of the axis of the eye, and no amount of force, effort or exertion can make it lie further off. If now the axis of a shortsighted eye is only so long that rays of light coming from a distance of 30 inches can be united upon the retina, it follows, if a glass concave 30 is placed in front of the eye, that objects which lie at a greater distance than thirty inches will also be portrayed correctly upon the retina; hence, if glasses are only used for distances situated at a further point than the far point of the short-sighted eye, their use is not only not dangerous, but highly beneficial, as they make surrounding objects perfectly distinct.

In our case, however, their use in the observation of objects situated more closely to the eye than thirty inches is extremely dangerous. I have said that we can distinguish printed or written matter up to three inches from our eyes. An otherwise

healthy eye, which can see objects perfectly well up to 30 inches, has a range of clear vision, without the aid of glasses, of from 3 to 30 inches; if glasses are used for matter which can be seen with the naked eye within this range, then the eye must overcome the glasses by exerting an undue force, or by accommodating. But by this means pressure within the eye is increased and the short sight increases in degree with every coming year.

It follows from the above that the selection of the proper glasses should be restricted to competent persons.

However, it occasionally is necessary for children to wear glasses for near work also. In cuch a case a *correcting* and not a *neutralizing* glass should be worn. But the further discussion of this subject would lead me too far, and would consume too much of your time; suffice it to say that teachers as well as parents are under great responsibility in this particular, and should not allow children to choose their own glasses, as by an improper choice irremediable harm is frequently done.

That badly printed books or such as are set in too small type are able to produce near-sight, I need scarcely tell you; it were, in fact, an excellent and much to be desired innovation in the system of teaching if instruction were more especially oral in those years of school life in which short-sight, on account of the extreme impressibility of the lining membranes of the eye, is most apt to be produced.

Such children should more particularly be relieved of all superfluous writing, as it is especially while thus employed that short-sight is developed.

Besides short-sight, there is another condition which merits attention in the discussion of the effect school life exerts upon children, although it is subordinate in its results to the extremely evil consequences which the state of the eye but now considered is so apt to call forth. I refer to *over-sight* or hypermetropia. You can best understand this condition by the following remarks, which are extracted from a lecture delivered by me upon a previous occasion:

"Sometimes the eyeball is too flat; and hence, rays of light which enter through the pupil are not brought to a focus as they

ought to be—*upon* the retina, but *behind* it. This condition is known as Over-sight, or *Hypermetropia.* When it is present, great pain is often caused the eyes, if no correcting glasses are worn; even children, six or seven years old, sometimes require them in order to do away with a great annoyance. The want of care on the part of parents and teachers in not attending in this particular to the eyes of those under their charge, in not immediately consulting an oculist, often produces unfortunate results, inasmuch as the majority of "cross-eyes" is produced by this condition. There are six muscles attached to the eyeball, governing its various motions. Now, the muscles which turn the eyes inward—the so-called internal recti muscles—in the attempt to increase the visual power of the eyes turn them towards the nose; this is done, so that rays of light which diverge, that is, such as come from a near point, may enter the eye, not obliquely, but in the direction of its axis. When we look at distant objects, the rays of light are parallel, and we do not employ this action, provided the eye is normally constructed. If, however, it is too flat, that is, if it is oversighted, then we bring these muscles almost constantly into play—not only for near objects, but also for the observation of those at a distance,—and the eyes are gradually brought into that permanent position, and an internal or convergent squint, or what is known as 'cross-eye' is produced."

In consequence of the excessive employment of these muscles, moreover, it is necessary that the eye be approached very closely to the book or the writing matter, and thus a condition which is the direct reverse of short sight is confounded there-with, and very disastrous results are induced. Such eyes require a convex glass, which by increasing the convergence of the rays of light brings forward the image which, on account of the shortened axis, is portrayed behind the retina, and is consequently blurred, and causes it to be distinctly pictured on the nervous lining membrane of our eyes.

Children affected with this condition will, by instinct or in sport, put on their grandmother's or grandfather's spectacles, and will immediately find that they can see as they have never been able to do before. Oojects will appear distinct to them, and they will

beg to be permitted to wear the glasses. The dread of parents that the eyes of their children will be ruined thereby prevents the granting of this request, and an internal squint is produced after a longer or shorter time.

But this is not all. An hypermetropic eye, on account of its construction, is able to see clearly neither in the distance nor near by; in the effort to see without glasses, therefore, its muscular apparatus is strained during the process of the accommodation. But an oversighted eye, as I have told you, accommodates all the time, both when looking at near and distant objects.

If you employ your arm for any length of time it will tire, and persistent use of it will cause pain; for the same reason the ciliary muscle as well as the internal recti being continuously and unduly active, the eye will be under a fatiguing strain. and painful vision, or what is known as *asthenopia*, will result.

You can scarcely form an idea to what inconvenience the child is put in consequence, and this consideration should make you very careful to have its eyes examined and supplied with what will not infrequently give it instant relief, that is the proper convex glasses.

In contradistinction to near-sightedness, which we found to have been hereditary in only an exceedingly small number of cases, *over-sight* is always and under all circumstances congenital. No amount of exertion or activity can change a healthy to an over-sighted eye.

My friend and colleague, Dr. Cohn, whose figures concerning short-sight I have informed you of, found that the proportion of over-sighted to short-sighted school children was as one to five, that is, he found that there were five times as many short-sighted as over-sighted children. This shows that near-sightedness is a much more frequent affection, and that against it more especially ought the attention of intelligent instructors to be directed. But the dangers resulting from neglect of the condition of over-sight dare not be overlooked either; and I hope that what I have said regarding its results will incite you to examine closely into the optical conditions of those entrusted to your care.

Ladies and gentlemen, if I have succeeded in making clear my

views concerning some of the evils consequent upon incorrect school arrangements and how to prevent them, I shall consider the time I have consumed to have been well spent. It is surely a matter of great importance to educate our children in such a manner that the noblest gift they are possessed of, that of vision is not made to suffer. It were difficult to enumerate how many fine intellects have been nipped in the bud, how many brilliant careers have been blighted by the evils consequent upon a defective school-hygiene.

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